

What is claimed is:

1. A method for optically inspecting and evaluating a sample, the method comprising:

5 measuring, by optical microscopy, the gross overlay between an upper layer and a lower layer of the sample;

projecting a probe beam at an overlay metrology target included in the sample, where the overlay metrology target includes one or more gratings built into the upper layer of the sample, each of which is paired with a respective grating built
10 into the lower layer of the sample;

analyzing the diffraction imparted to the probe beam by the gratings of the overlay target to measure fine overlay between the upper and lower layers;

generating a total overlay measurement that is consistent with both the fine and gross overlay measurements.
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2. A method as recited in claim 1 in which the gross overlay is measured using the images of one or more pairs of gratings.

3. A method as recited in claim 2 in which at least one grating-pair has gratings
20 of different size in the upper and lower layers.

4. A method as recited in claim 1 in which gross overlay is measured using an imaging system that is used for navigation or pattern recognition to locate the overlay metrology targets.
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5. A method as recited in claim 1 in which the total overlay measurement equals the gross overlay if the gross overlay exceeds a threshold, and the total overlay measurement equals the fine overlay if the gross overlay is equal to or less than the threshold.

6. A method as recited in claim 1 in which the method further comprises the steps of:

determining a range of unambiguous fine overlay measurements;

5 determining from the gross overlay measurement the integer count of whole fine-measurements ranges nearest to the total overlay;

forming a product by multiplying the integer count by the range fine-measurement range; and

adding or subtracting the fine overlay measurement to the product.

10 7. An overlay metrology target that comprises: one or more upper gratings formed on an upper layer of a sample, each paired with a respective lower grating formed on a lower layer of the sample; with at least one grating on the upper layer differing in at least one dimension or shape than its grating pair.

15 8. An overlay target as recited in claim 7 in which in which one grating is differently sized in the X dimension than its grating pair and one grating is differently sized in the Y dimension than its grating pair.

20 9. An overlay target as recited in claim 7 in which one grating is differently sized in the X and Y dimensions than its grating pair.

10. An overlay target as recited in claim 7 in which each grating is formed as a parallel series of lines.

25 11. An overlay target as recited in claim 10 in which the lines in the upper and lower grating of each pair are parallel to each other and at least one grating differs from its pair in the dimension that is parallel to the grating lines.

30 12. An overlay target as recited in claim 7 in which each grating is formed as a two dimensional array of three dimensional features.

13. A method for controlling overlay within semiconductor wafers, the method comprising:

5 forming an overlay metrology target included in a sample, where the overlay metrology target includes one or more gratings built into an upper layer of the sample, each of which is paired with a respective grating built into a lower layer of the sample;

measuring the gross overlay between the upper layer and the lower layer of the sample;

10 measuring the fine overlay between the upper layer and the lower layer of the sample; and

generating a total overlay measurement that is consistent with both the fine and gross overlay measurements.

14. A method as recited in claim 13 in which at least one grating-pair has gratings of different size in the upper and lower layers.

15. A method as recited in claim 13 in which gross overlay is measured using an imaging system that is used for navigation or pattern recognition to locate the overlay metrology targets.

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16. A method as recited in claim 13 in which at least one grating on the upper layer differs in at least one dimension or shape than its grating pair.

17. A method as recited in claim 16 in which one grating is differently sized in the X dimension than its grating pair and one grating is differently sized in the Y dimension than its grating pair.

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18. A method as recited in claim 16 in which one grating is differently sized in the X and Y dimensions than its grating pair.

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19. A method as recited in claim 13 in which each grating is formed as a parallel series of lines.

20. A method as recited in claim 19 in which the lines in the upper and lower
5 grating of each pair are parallel to each other and at least one grating differs from its pair in the dimension that is parallel to the grating lines.

21. A method as recited in claim 13 in which each grating is formed as a two dimensional array of three-dimensional features.

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22. A method for monitoring overlay in a semiconductor wafer comprising the steps of:

forming an overlay metrology target included in a sample, where the overlay metrology target includes at least one pair of gratings, one grating of the pair being
15 built into an upper layer of the sample and the other grating of the pair being built into a lower layer of the sample, with the grating in the upper layer differing in at least one dimension or shape from the grating in the lower layer;

measuring the gross overlay between the upper layer and the lower layer of the sample using optical microscopy;

20 measuring the fine overlay between the upper layer and the lower layer of the sample using a scatterometry approach; and

generating a total overlay measurement that is consistent with both the fine and gross overlay measurements.

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